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SPECIAL THEORY OF RELATIVITY UNDER THREAT

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ABSTRACT

In optics experiments are conducted on the wave nature of light. Interferometers are used for measurements and two waves are superimposed to generate interference fringes. In such an experiment Michelson and Morley used Michelson interferometer to measure the velocity of earth in a stationary ether. The null results of this experiment could not be explained, various other experiments were conducted such as kennedy-Thorndike experiment, Dayton- Miller experiment, Raleigh and Brace experiment, Michelson- Gale- Pearson experiment, but all experiments gave null results. While interpreting the result of these experiments a very important role of wavefront of light has been ignored. Present work describes the role of wavefront of light in these experiments conducted on the wave nature of light and describes that actually no length contraction and time dilation like phenomenons exist as stipulated by special theory of relativity.

KEYWORDS: Interferometer, Interference Fringes, Wavefront

INTRODUCTION

Failure of Michelson and Morley experiment led to the two postulates of Special Theory of Relativity. The second postulate of STR states that speed of light in vaccum is the same for all observers, regardless of the motion of light source or observer. On the basis of postulates of special theory of relativity it has been derived that length contraction and time dilation like phenomenons exist. Constancy of speed of light means no real addition of velocity is possible in the velocity of light, but relative addition and subtraction in the velocity of light is equally possible as per classical mechanics. Light cannot effect already occurred movements of objects before its reaching at the destination.

Experiment

In Michelson and Morley experiment plane wavefront of light is made to fall upon the glass plate and the wavefront is splitted into two parts, both the parts of wavefront travelling at right angles to each other are reflected back by two mirrors placed at equal distance from the beam splitter and are reunited at one point and interference fringes are observed. The interferometer is adjusted with one arm pointing the direction of motion of earth and the other perpendicular to it. While calculating the time taken by the wavefronts of light the role of wavefront was not considered resulting into wrong derivation of time taken by light waves traversing different paths. Let us discuss the correct time taken by two beams. As shown in figure I below a parallel wavefront of light source S is made to fall upon the glass plate P thinly silvered at the back side. The wavefront strikes the plate at point O. The wave going towards mirror M_1 takes time t_1 to reach the mirror but by this time t_1 mirror M_1 has also moved along the motion of earth with velocity v hence the length covered by light wave will be $L+vt_1$, where L is the distance of mirror M_1 from plate P and light has travelled with velocity c in time t_1 covering the distance ct_1.

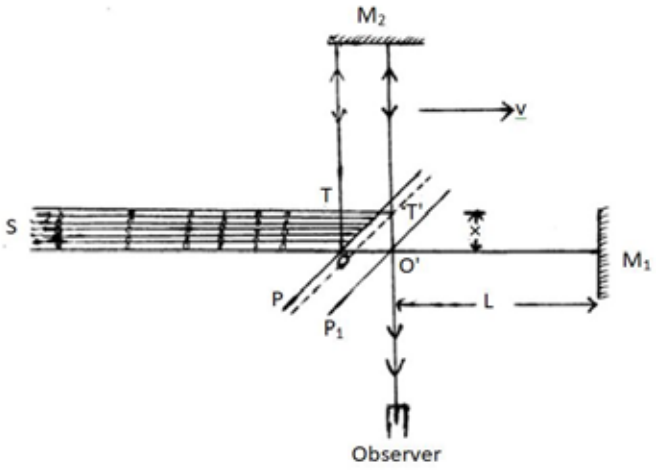


Fig - I

therefore $ct_1 = L + vt_1$

$ct_1 - vt_1 = L$

$t_1 (c - v) = L$

$$t_1 = \frac{L}{c - v}$$

for inward journey from mirror M_1 to P, let the time taken by light be t_2 , but by the time t_2 plate itself has moved towards coming light by factor vt_2 hence light wave has travelled the distance $L-vt_2$, light wave travelled the distance ct_2 with velocity c

therefore $ct_2 = L - vt_2$

$ct_2 + vt_2 = L$

$t_2(c+v) = L$

$$t_2 = \frac{L}{c+v}$$

The total time taken by light wave from P to M_1 and M_1 to P with velocity c will be t_1+t_2

therefore $t = t_1 + t_2$

$$t = \frac{L}{c-v} + \frac{L}{c+v} = \frac{Lc+Lv+Lc-Lv}{(c-v)(c+v)}$$

$$= \frac{2Lc}{c^2-v^2} = \frac{2L}{c}\frac{1}{1-\frac{v^2}{c^2}}$$

$$t = \frac{2L}{c}\frac{1}{1-\frac{v^2}{c^2}} \quad \text{..... I}$$

The wavefront reflected from glass plate P (inclined at 45^0) towards mirror M_2 will get reflected according to Huygen's principle and will go perpendicularly. In previous all works calculations were made by considering automatic cross stream path of light which is not correct. Cross stream path can only be considered when the moving earth is dragging to the light in its direction of motion. Light wavefront will go independently irrespective of the motion of apparatus or earth. By the time wavefront returns to the glass plate P the plate has moved to the new position P_1 moving with velocity v as shown in figure I. All parts of a wavefront vibrates in phase hence the another part of the same wavefront will reach at the plate on the point o' where transmitted wavefront reaches.

Let O be the point where the wavefront OT strikes at plate P. The upper part of plane wavefront is at point T. Let T' be the point where the upper part of wave front OT strikes at the plate P after time t_1. Let O' be the point where the reflected part of wave front striking at T' will reach after reflection from mirror M_2.

Let the total time taken by the wavefront traversing path TT' M_2O' be t hence OO' = vt where v is the velocity of interferometer. The upper part of wave front OT is striking the plate P at T' after time t_1, therefore TT' = ct_1 where c is velocity of light

as OO' = TT' so $ct_1 = vt$

and $t_1 = \frac{vt}{c}$ ..... (i)

The distance O'T' is somewhat less than OO' by factor vt_1, because by the time wavefront T reaches T' the interferometer moved towards mirror M_1 in this time t_1 Therefore the distance O'T' = x = vt – vt_1 as (OO' = vt). Thus the distance travelled by the wavefront from. T T'M_2O' is calculate as under

$$TT'M_2O' = T\,T' + T'\,M_2 + M_2O' = vt + (L - x) + L$$

total time $t = \frac{vt}{c} + \frac{L-X}{c} + \frac{L}{c}$

$= \frac{vt}{c} + \frac{L-(vt-vt_1)}{c} + \frac{L}{c}$ (because x = vt – vt_1)

$= \frac{vt}{c} + \frac{L}{c} - \frac{vt}{c} + \frac{vt_1}{c} + \frac{L}{c}$

$= \frac{2L}{c} + \frac{vt_1}{c}$

$= \frac{2L}{c} + \frac{v}{c}\left(\frac{vt}{c}\right)$ (putting the value of t_1 from equation –i)

$= \frac{2L}{c} + \frac{v^2t}{c^2}$

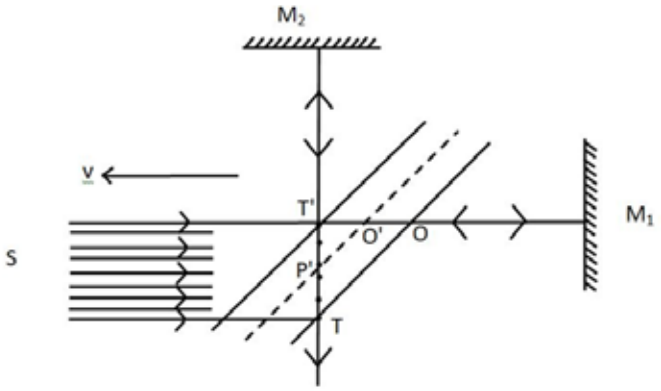
$t - \frac{v^2t}{c^2} = \frac{2L}{c}$

$t\left(1 - \frac{v^2}{c^2}\right) = \frac{2L}{c}$

$$t = \frac{2L}{c}\frac{1}{1-\frac{v^2}{c^2}} \quad \text{..... II}$$

As per equation No I and II both the parts of same wave front OT will reach at the point O' by taking equal time after reflection from mirror M_1 and M_2 and no path difference is involved due to motion of earth towards mirror M_1 In earlier works path difference was worked out which led to physics wrong way.

Let us consider the case when earth is moving in opposite direction as shown in figure II below



Observer

Fig II

The parallel wave front of light TT' strikes at the plate P at point T. Let the distance TT' = T' O= vt + vt_1 where v is the velocity of earth. By the time t_1 light travels from T' to O' with velocity c. hence T'O' = c t_1, in this time t_1 plate P has moved from O to O' hence OO'=vt_1. Time taken by light to complete its journey from O' to mirror M_1 and back to reach at T' be t and in this time t plate has moved the distance O'T'= vt

therefore $O'T' = ct_1 = vt$

$ct_1 = vt$

$t_1 = \frac{vt}{c}$ ..... (i)

The wavefront at T will also move towards mirror M_2 in time t_1 and reaches at point P' hence $TP' = ct_1 = vt$ and $P'T' = vt_1$. The distance travelled by light from P' to mirror M_2 and Back from M_2 to T' where light wave going towards mirror M_1 reaches will be $P'T' + T'M_2 + M_2T'$ Therefore time t to complete this distance by wavefront will be as under.

$$t = \frac{P'T'}{C} + \frac{T'M_2}{C} + \frac{M_2T'}{C}$$

$$= \frac{vt_1}{c} + \frac{L}{C} + \frac{L}{C}$$

$$= \frac{v}{c}\frac{(vt)}{C} + \frac{2L}{C} \text{ (by putting the value of } t_1 \text{ from equation-i)}$$

$$= \frac{v^2}{c^2}\, t + \frac{2L}{c}$$

$$t - \frac{v^2}{c^2}\, t = \frac{2L}{c}$$

$$t\left(1 - \frac{v^2}{c^2}\right) = \frac{2L}{c}$$

$$t = \frac{2L}{c}\,\frac{1}{1-\frac{v^2}{c^2}}$$

As discussed above both the waves of light going towards mirrors M_1 and M_2 perpendicular to each other takes equal time and no path difference is involved.

RESULTS AND DISCUSSION

In the Michelson and Morley experiment we are considering motion of earth in one plane only, but earth may be moving in any direction in three dimensional space. If one degree angle is treated as one direction then there are $(360^0 \times 180^0)$ =65180-(358 common directions) =64442 directions in spherical space in which earth may be moving and there is only one direction towards mirror M_2 and opposite in which there is some possibility of expected fringe shift, but to achieve this situation is next to impossible and in other directions minor fringe shifts may be observed. Dayton-Miller always observed small fringe shifts in his experiments conducted so many times. There is practical difficulty in Michelson and Morley experiment. When earth is moving in any direction in three dimensional space the wavefront of light plays very important role and compensates the changes due to rotation of interferometer, however small fringe shifts may be observed. Similarly in all other such experiments wavefront plays its role and results of these experiments are also to be analysed in view of above facts.

CONCLUSION

Light travels with its constant velocity means that no real addition and subtraction of velocity of source of light, observer or any object is possible in the velocity of light. Movements of other objects before reaching of light at the spot are equally effective as per classical Mechanics. Sagnac experiment has already proved that movements already occurred before reaching the light at a point are countable. Relativistic addition and subtraction of velocities is only a mathematical puzzle based on assumptions. In real sense no length contraction or time dilation like phenomenons exist.